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PII: S1226-086X(19)30033-4
DOI: https://doi.org/10.1016/j.jiec.2019.01.041
Reference: JIEC 4383

To appear in:

Received date: 1 December 2018
Revised date: 16 January 2019
Accepted date: 27 January 2019

Please cite this article as: Ebrahimi R, Maleki A, Zandsalimi Y, Ghanbari R, Shahmoradi B, Rezaee R, Safari M, Joo SW, Daraei H, Harikaranahalli Puttaiah S, Giahi O, Photocatalytic degradation of organic dyes using WO_3-doped ZnO Nanoparticles fixed on a glass surface in aqueous solution, *Journal of Industrial and Engineering Chemistry* (2019), https://doi.org/10.1016/j.jiec.2019.01.041

Photocatalytic degradation of organic dyes using WO_3-doped ZnO Nanoparticles fixed on a glass surface in aqueous solution

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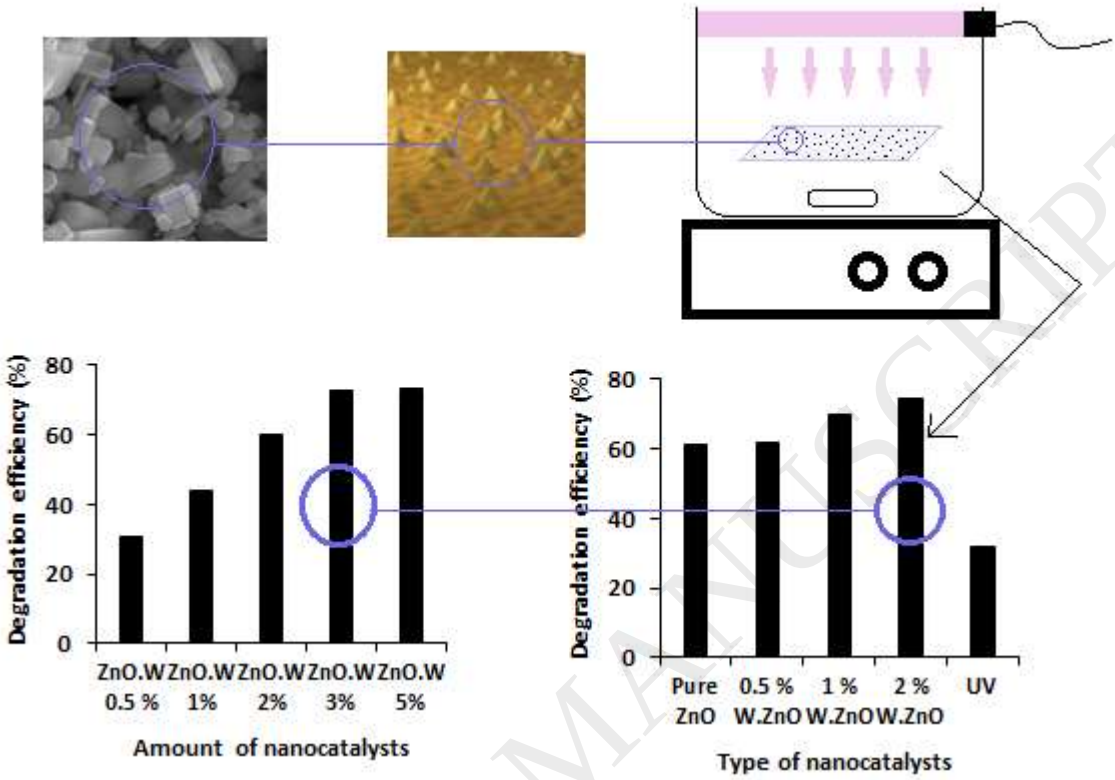
Highlights

- WO_3 doped ZnO NPs was used for photocatalytic degradation of direct blue 15 dye under UV light irradiation.
- SEM, XRD, FTIR, Zeta potential and AFM corroborated the synthesis of ZnO doped NPs.
- Photocatalytic activity of ZnO NPs was improved after doping with tungsten.
- Removal of Direct Blue 15 dye was the highest under acidic pH.
- The stabilization of the nanoparticle was done to reduce the amount of nanocatalysts consumption and its release rate.

Graphical abstract



Abstract

The present study aimed at evaluating the application of tungsten oxide-doped zinc oxide nanoparticles for the photocatalytic degradation of Direct Blue 15 dye in a sequencing batch reactor. ZnO nanoparticles were doped with WO_3 through hydrothermal synthesis method. To characterize the synthesized nanoparticles scanning electron microscopy, X-ray diffraction, Fourier transform infrared spectroscopy, atomic force microscopy, zeta potential analysis, and ultraviolet-visible spectroscopy were used. The radiation source in this study was five 6W UV lamps. Operational parameters affecting the process, namely pH, light intensity, dopant percentage, dye concentration, and contact time, were evaluated. The results of the present study revealed that the efficiency of the photocatalytic process for the degradation of organic dyes was

higher at acidic pH values than neutral or basic values. In addition, upon increasing the light intensity from 172 to 505 W/m^2, the efficacy of dye degradation was enhanced from 27.8 to 73.5%. Increasing the concentration of the dopant percentage from 1 to 5% w/v increased the degradation efficacy from 30.69 to 73.1%. Increasing the initial dye concentration from 20 to 100 mg/L decreased the degradation efficacy from 86.9 to 37.5%. Photocatalytic process using WO_3-doped ZnO nanoparticles fixed on a glass surface thus was proven to show a good efficiency for the degradation of organic dye in aquatic solutions.

Keywords: Photocatalytic degradation; organic dye; Zinc Oxide; WO_3; doping